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(54) Title: GAUGE CALIBRATION

(57) Abstract: A method of calibrating a gauge in particular for the measurement of film thickness, uses a calibration variable to compensate for short term changes in probe tip condition, instead of a constant value. A calibration constant is based only on the dielectric constant for a coating such as lacquer, and is independent of the probe tip variable.

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GAUGE CALIBRATION

This invention relates to gauge calibration. In particular, but not exclusively, it relates to the calibration of gauges for measuring the weight/thickness of coatings such as lacquer applied to metals such as tinplate used in the can making trade.

Capacitance based film weight gauges are known which are used for the measurement of dry film "weight". Whilst measurements taken by such known gauges are accurate, their calibration and stability over time is poor. In these gauges, a panel of known film weight is used to programme a selected channel to give the correct film weight when a measurement is taken. The panel allows the meter to be programmed with a factor K which relates the capacitance measured by the gauge to the film weight. This factor is a function of the dielectric constant of the lacquer such that the film weight is computed from the product of the capacitance and this factor K. The value obtained on the gauge is a linear correction of the capacitance measured and allows the measurement of the film weight of this particular lacquer on production sheet metal.

One major problem with this known system is that recalibration is time consuming and needs to be carried out independently for each channel of the gauge, typically 40 or more channels being used. As a panel is required for checking each of the 40+ channels which are programmed, this inevitably leads to infrequent recalibration. These panels are also not produced to a common, traceable standard and are prone to damage and consequent inaccuracy through repeated usage.

A further problem with known gauges is that there is no way of quantifying either the condition of the tip of the probe which is used together with the gauge, or any contamination of the probe tip.

5 This invention seeks to provide a method of calibrating a film thickness gauge which is a single operation and which also compensates for any deterioration in probe tip condition.

10 According to the present invention, there is provided a method of calibrating a gauge for measuring film thickness/weight, the gauge including a probe, the method comprising the steps of:

15 (a) determining a universal calibration constant for a material from a first standard having a known capacitance and weight;

 (b) measuring the weight of a second standard of known weight;

20 (c) calculating the difference between the measured weight and the known weight of the second standard to obtain a calibration variable; and

 either (c) resetting the calibration variable so that the measured weight of the second standard corresponds to its known weight, thereby recalibrating the gauge, or (d) cleaning the tip of the probe.

25 The Applicant has recognised that the factor K of known systems is not a true constant. In practice, this factor K comprises one true universal calibration constant comprising $K_{\text{lacquer dielectric}}$ and a calibration variable $K_{\text{probe tip}}$ which compensates for short term changes
30 in the condition of the probe tip. Prior to this

invention, degradation of probe tip was considered to be adequately compensated for by cleaning of the probe tip and was therefore combined with the calibration constant as a single factor K for measurement purposes.

5 The calibration constant is a factor derived for each lacquer which relates the dielectric of the lacquer to that of a standard material used for calibration. Once determined, the value is fixed and is a universal calibration constant which is the same for this material
10 in every plant, independent of location. This standard therefore does not require storage on site except as a constant value "stored" in a computer database or programme, for example. There is thus no requirement to hold a library of standards on site, as required by prior
15 art gauges. Furthermore, as this standard is a true constant, the value of the standard does not require rechecking when each film weight measurement is taken.

 The calibration variable $K_{\text{probe tip}}$ is determined before each sheet is measured by checking the value
20 obtained from a stable and robust standard which is held with the gauge in the factory or on site. In one preferred embodiment of the invention, this standard is a laminate and may ideally include a layer of polyethylene terephthalate (PET) which is robust and has similar
25 electrical properties to conventional coatings. Trials have also shown that the level of correlation of laminate standards performance with a range of lacquers is extremely high.

 Clearly the use of a calibration variable is better
30 able to correct for any probe tip degradation than the

visual inspection of prior art gauges. This single robust second standard is held on site and enables regular calibration of the gauge and/or before each film weight measurement, thus maximising the accuracy of the gauge.

- 5 Recalibration of the gauge is carried out when the specified value of the second standard cannot be achieved by cleaning of the probe tip.

 Preferably the invention further comprises the steps of (e) placing a capacitance of known value in series
10 with the gauge; and (f) measuring the capacitance of a circuit formed by the gauge and known capacitor to obtain an indication of the degree of deterioration of the probe tip and any need for resetting the value of the calibration variable.

- 15 Known gauges have no means of recording deterioration of the probe tip over an extended period of time and so are unable to detect when a probe tip might need changing. By using a fixed capacitor to check the reading on the gauge independently of the condition of
20 the probe tip, cumulative recalibrations can be tracked. In this instance, the gauge measurement is directly proportional to the value of the calibration variable as the capacitance and calibration constant are fixed. The calibration variable is, in turn, related to probe tip
25 condition.

- By using a panel comprising a known standard film to recalibrate the gauge and by checking the probe tip for degradation using a standard capacitor, the method of the present invention provides a system which enables one-
30 off calibration for films and lacquers on-site, in

factory environments or in the laboratory, as required. By checking for probe tip damage, calibration for drift in readings due to probe condition is applicable to all readings and can be set "globally" on a single channel
5 using a single standard.

Example 1

The lacquer calibration constant for a lacquered panel was determined from panel standards as 0.233 and
10 this value was saved in a computer data base. The calibration variable of a laminate standard was determined from master standards as 75. Probe tip condition was checked by use of a capacitor placed in series with the gauge. Capacitance readings for a film
15 were converted to film weight and multiplied by 0.233 to give actual film weights. Resultant data was stored.

Any change observed in the lacquer standard was also observed in the laminate standard. Any changes were found to be due to probe tip contamination rather than drift in
20 lacquer properties. By referring to a measurement of pure capacitance, any degradation of the probe tip was assessed and the need for replacement probe tip rather than continued recalibration was determined.

CLAIMS

1. A method of calibrating a gauge for measuring film weight, the gauge including a probe, the method comprising the steps of:
 - (a) determining a universal calibration constant for a material from a first standard having a known capacitance and weight;
 - (b) measuring the weight of a second standard of
5 known weight;
 - (c) calculating the difference between the measured weight and the known weight of the second standard to obtain a calibration variable; and
10 either (c) resetting the calibration variable so that the measured weight of the second standard corresponds to its known weight, thereby recalibrating the gauge, or (d) cleaning the tip of the probe.
2. A method according to claim 1, in which the second standard is a laminate.
3. A method according to claim 1 or claim 2 in which the second standard includes a layer of polyethylene terephthalate.
4. A method according to any one of claims 1 to 3, further comprising the steps of:
 - (e) placing a capacitance of known value in series with the gauge; and

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(f) measuring the capacitance of a circuit formed by the gauge and known capacitor to obtain an indication of the degree of deterioration of the probe tip.

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A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01B G01G G01N G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 020 264 A (GUTHRIE WILLIAM L ET AL) 1 February 2000 (2000-02-01) abstract	1
A	US 5 293 132 A (KOCH FRANK J) 8 March 1994 (1994-03-08) abstract	1
A	US 4 996 658 A (BAKER RUSS J) 26 February 1991 (1991-02-26) abstract	1



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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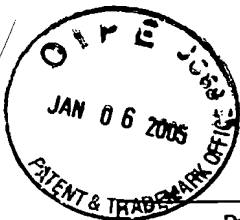
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